

Application Serial No.: 09/862,418
Applicant(s): Chang et al.

Docket No.: N.C. 79,764

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

Claims 1 (currently amended): An immobilized catalyst for the aqueous phase hydrolysis of phosphate or phosphono or phosphoro groups, comprising a catalytically and hydrolytically active complex of a chelated metal ion immobilized on a support in contact with an aqueous solution; wherein when the chelators are immobilized on the support in the aqueous solution they are capable of hydrolyzing phosphate, phosphono groups, phosphoro groups, or any combination thereof.

Claim 2 (previously presented): The immobilized catalyst of claim 1, wherein the support is in the form of solid particles.

Claim 3 (previously presented): The immobilized catalyst of claim 2, wherein the support comprises a material selected from the group consisting of silica and chitosan.

Claim 4 (previously presented): The immobilized catalyst of claim 1, wherein the support is a porous solid material.

Claim 5 (previously presented): The immobilized catalyst of claim 1, wherein the support is in the form of a wipe, sponge or filter.

Claim 6 (previously presented): The immobilized catalyst of claim 1, wherein the support is a polymeric solid.

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Claim 7 (currently amended): The immobilized catalyst of claim 1, wherein the catalytically active chelated metal ion contained in the immobilized metal chelate complex is selected from the group consisting of Zn(II), Cu(II), Co(III), Fe(III), Pb(II), Mg(II), Mn(III), Ni(II), La(III), Ce(III) and Eu(III).

Claim 8 (previously presented): The immobilized catalyst as claimed in claim 1, wherein the support is a self-organized polymolecular association.

Claim 9 (currently amended): The immobilized catalyst of claim 8, wherein the self-organized polymolecular association support is ~~a support~~ selected from the group consisting of liposomes, micelles and tubules.

Claim 10 (previously presented): The immobilized catalyst of claim 1, wherein the metal ion is complexed with a chelating agent selected from the group consisting of bipyridines, terpyridines, cyclic chelating agents, and acrylic group-containing chelating agents.

Claim 11 (previously presented): The immobilized catalyst of claim 10, wherein the metal ion is complexed with a chelating agent selected from the group consisting of 4-vinyl-4'-methyl-2,2'-bipyridine, 1,4,7-triazacyclononane, 1,4,7,10-tetraazacyclododecane, tris-(3-aminopropyl)amine and analogs and derivatives of these compounds which can chelate to complex with the metal ion.

Claim 12 (currently amended): A method of making an immobilized catalyst for the aqueous phase hydrolysis of phosphates or phosphono or phosphoro groups in accordance with claim 1, the method comprising the steps of:

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- (a) providing at least one chelate which includes a chemically reactive group;
- (b) chemically reacting the chelate with a support utilizing the chemically reactive group contained in the chelate to form a support with the chelate covalently bonded thereto; and
- (c) contacting the chelate-containing support with a metal ion to complex the metal ion with the chelate-containing support such that the resultant metal chelate complex is capable of catalyzing the hydrolysis of one or more phosphates and ~~phosphate esters~~ phosphono or phosphoro groups.

Claim 13 (original): The method of claim 12 wherein the chemically reactive group contained in the chelate is selected from the group consisting of amino groups, epoxide groups, acrylates, vinyl groups and silyl groups.

Claim 14 (previously presented): The method of claim 12 wherein the support is capable of adsorbing a material selected from the group consisting of phosphates and phosphate esters.

Claim 15 (currently amended): A method of making an immobilized catalyst for the aqueous phase hydrolysis of phosphono or phosphoro groups as claimed in claim 1, the method comprising the steps of:

- (a) providing a first monomer comprising at least one chelate and at least one polymerizable group; and
- (b) polymerizing the monomer to form a polymer having a plurality of covalently bound chelate groups;
- (c) contacting ~~one of the monomer or~~ the polymer with a metal ion in an aqueous solution such that the resultant polymer contains a plurality of covalently bound metal chelate

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complexes and is capable of catalyzing the hydrolysis of one or more phosphates and phosphate esters.

Claim 16 (previously presented): The method of claim 15, wherein the monomer comprising at least one chelate is reacted with at least one additional monomer in step (b) to provide a co-polymeric support.

Claim 17 (currently amended): The method of claim 16, wherein support is capable of adsorbing compounds which contain one or more phosphate, phosphono and phosphoro groups in a manner that enhances catalysis.

Claim 18 (canceled)

Claim 19 (previously presented): The method of claim 15, wherein the monomer is selected from the group consisting of vinyl monomers and acrylic monomers.

Claim 20 (previously presented): The method of claim 19, wherein the monomer is selected from the group consisting of 2-ethyl-2(hydroxymethyl)propane-trimethacrylate, divinyl benzene, acrylic acid, methacrylic acid, trifluoro-methacrylic acid, 2-vinylpyridine, 4-vinylpyridine, 3(4)vinylimidazole, p-methylbenzoic acid, itaconic acid, 1-vinylimidazole, and mixtures thereof.

Claim 21 (withdrawn): A method for the decontamination of a compound which contains one or more phosphate, phosphoro and phosphono groups, the method comprising the step of:

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contacting the compound with at least one immobilized metal chelate complex as claimed in claim 1 for a time period sufficient to hydrolyze at least some of the phosphate, phosphono or phosphoro groups in said compound.

Claim 22 (withdrawn): The method as claimed in claim 21, wherein the immobilized metal chelate complex is immobilized on a support which is capable of adsorbing said compound and said contacting step is carried out for a time period sufficient to also permit adsorption of at least some of said compound onto the support..

Claim 23 (withdrawn): The method as claimed in claim 22, further comprising the step of treating the support with a metal ion capable of catalyzing the hydrolysis of one or more groups selected from the group consisting of phosphate groups, phosphono groups and phosphoro groups to hydrolyze at least some of the adsorbed compound.

Claim 24 (withdrawn): The method as claimed in claim 23, wherein the metal ion is complexed with a chelating agent selected from the group consisting of bipyridines, terpyridines, cyclic chelating agents, and acrylic group-containing chelating agents.

Claim 25 (withdrawn): The method as claimed in claim 24, wherein the metal ion is complexed with a chelating agent selected from the group consisting of 4-vinyl-4'methyl-2,2'-bipyridine, 1,4,7-triazacyclononane, 1,4,7,10-tetraazacyclododecane, tris-(3-aminopropyl)amine and analogs and derivatives of these compounds which exhibit an effective level of chelating activity to complex with the metal ion.

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Claim 26 (withdrawn): The method as claimed in claim 24, wherein the metal ion is selected from the group consisting of Zn(II), Cu(II), Co(III), Fe(III), Pb(III), Mg(II), Mn(III), Ni(III), La(III), Ce(III) and Eu(III).

Claim 27 (withdrawn): A method for the decontamination of a compound which contains one or more phosphate, phosphono and phosphoro groups, the method comprising the step of:
contacting the compound with at least one support that is capable of adsorbing the compound for a time period sufficient to adsorb at least some of the compound.

Claim 28 (withdrawn): The method as claimed in claim 27, further comprising the step of treating the support containing the adsorbed compound with a metal ion capable of catalyzing the hydrolysis of a phosphate ester to hydrolyze at least some of the phosphate, phosphono or phosphoro groups in said compound.

Claim 29 (withdrawn): The method as claimed in claim 28, wherein the metal ion is complexed with a chelating agent selected from the group consisting of bipyridines, terpyridines, cyclic chelating agents, and acrylic group-containing chelating agents.

Claim 30 (withdrawn): The method as claimed in claim 29, wherein the metal ion is complexed with a chelating agent selected from the group consisting of 4-vinyl-4'methyl-2,2'-bipyridine, 1,4,7-triazacyclononane, 1,4,7,10-tetraazacyclododecane, tris-(3-aminopropyl)amine and analogs and derivatives of these compounds which exhibit an effective level of chelating activity to complex with the metal ion.

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Claim 31 (withdrawn): The method as claimed in claim 29, wherein the metal ion is selected from the group consisting of Zn(II), Cu(II), Co(III), Fe(III), Pb(III), Mg(II), Mn(III), Ni(III), La(III), Ce(III) and Eu(III).